Second European Workshop on Advanced Life Support

INTEGRITY -- Integrated Human Exploration Mission Simulation Facility

It is proposed to develop a high-fidelity ground facility to carry out long-duration human exploration mission simulations. These would not be merely computer simulations – they would in fact comprise a series of actual missions that just happen to stay on earth. These missions would include all elements of an actual mission, using actual technologies that would be used for the real mission. These missions would also include such elements as extravehicular activities, robotic systems, telepresence and teleoperation, surface drilling technology—all using a simulated planetary landscape. A sequence of missions would be defined that get progressively longer and more robust, perhaps a series of five or six missions over a span of 10 to 15 years ranging in duration from 180 days up to 1000 days. This high-fidelity ground facility would operate hand-in-hand with a host of other terrestrial analog sites such as the Antarctic, Haughton Crater, and the Arizona desert. Of course, all of these analog mission simulations will be conducted here on earth in 1-g, and NASA will still need the Shuttle and ISS to carry out all the microgravity and hypogravity science experiments and technology validations.

The proposed missions would have sufficient definition such that definitive requirements could be derived from them to serve as direction for all the program elements of the mission. Additionally, specific milestones would be established for the "launch" date of each mission so that R&D programs would have both good requirements and solid milestones from which to build their implementation plans. Mission aspects that could not be directly incorporated into the ground facility would be simulated via software.

New management techniques would be developed for evaluation in this ground test facility program. These new techniques would have embedded metrics which would allow them to be continuously evaluated and adjusted so that by the time the sequence of missions is completed, the best management techniques will have been developed, implemented, and validated. A trained cadre of managers experienced with a large, complex program would then be available.

Three other critical items of this approach are as follows:

1) International Cooperation/Collaboration. New paradigms and new techniques for international collaboration would be developed. These paradigms can be developed to include built-in metrics to allow for improvements ultimately to yield proven paradigms for application in the real mission. Note that since this approach is much lower cost than an actual flight mission, smaller countries that could not afford to participate in a program as large as the ISS can become partners. As a result, these nations—along with their citizens—become advocates for human space exploration as well. Since eventual human planetary exploration missions are likely to be truly international, the means for building the requisite working relationships are through cooperative research and technology development activities.

2) Commercial Partnering. Improved paradigms for commercial partnering would be developed - both U.S. and international commercial entities. An examination of what commercial entities would like to gain, what they would expect to contribute, and what NASA wants out of such a relationship would be determined to develop appropriate paradigms. Again, metrics would be included such that continual evaluations can be conducted and adjustments can be made to the working paradigms. Then, after these ground missions are completed, a proven set of paradigms (and a cadre of people trained and comfortable with their use) would be available for the actual mission. Again, since this is a much lower cost program (lower than an actual flight mission), smaller domestic and international commercial entities can participate.

3) Academic Partnering. Improved paradigms for academic partnering can be developed — both U.S. and international academic institutions. Academic institutions represent a tremendous pool of expertise and creative talent – just what is need for a human planetary exploration mission. Academia would likely view this ground test facility as a tremendous teaching tool for a variety of disciplines, including science, engineering, medicine, and management.

Donald L. Henninger, Ph.D.
Manager, Advanced Life Support
NASA - Johnson Space Center
Mail Code EC
Houston, TX 77058
281-483-5034 (voice)
281-483-5060 (fax)
1-888-617-8975 (pager)
donald.l.henninger1@jsc.nasa.gov